



## SDC SOLENOID DESIGN NOTE #197

TITLE: Cryostat-to-Calorimeter Supports

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This design note contains the viewgraphs sent to Charles Collins (SSCL) for him to present at the meeting of the SDC Integration Group on April 29. They represent our present thinking on the supports. We hope to get some feedback from the meeting.

# STRUCTURAL REQUIREMENTS OF CRYOSTAT-TO-CALORIMETER SUPPORT SYSTEM

Design axial decentering force: 40 tonnes

Stiffness:  $(\partial F_z / \partial z)$  of support system  $\geq 10 (\partial F_z / \partial z)$  of coil

Maximum allowable deflection: 2 mm

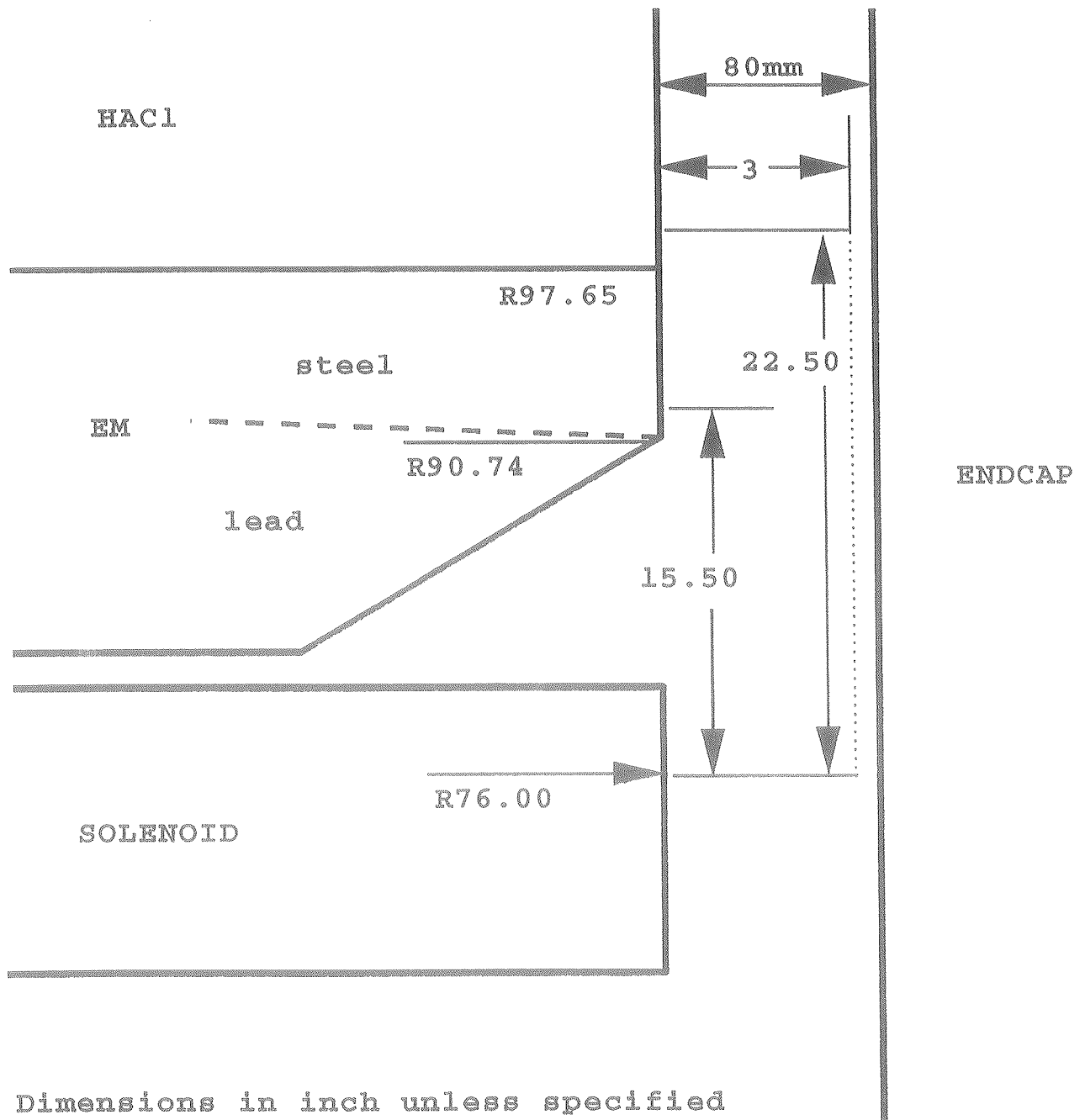
Materials: Al--good radiation thickness. Modulus low.

Ti-- radiation thickness OK(?). Good mechanical properties.

CFRP--very good radiation thickness. Properties uncertain.

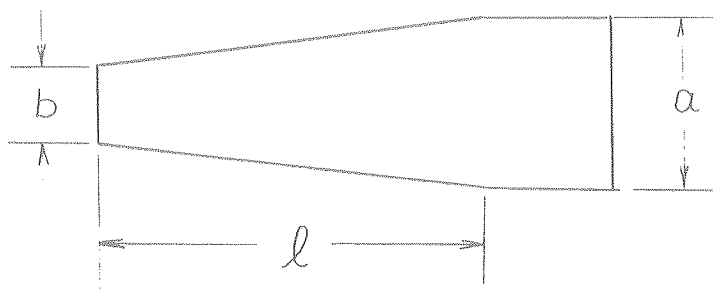
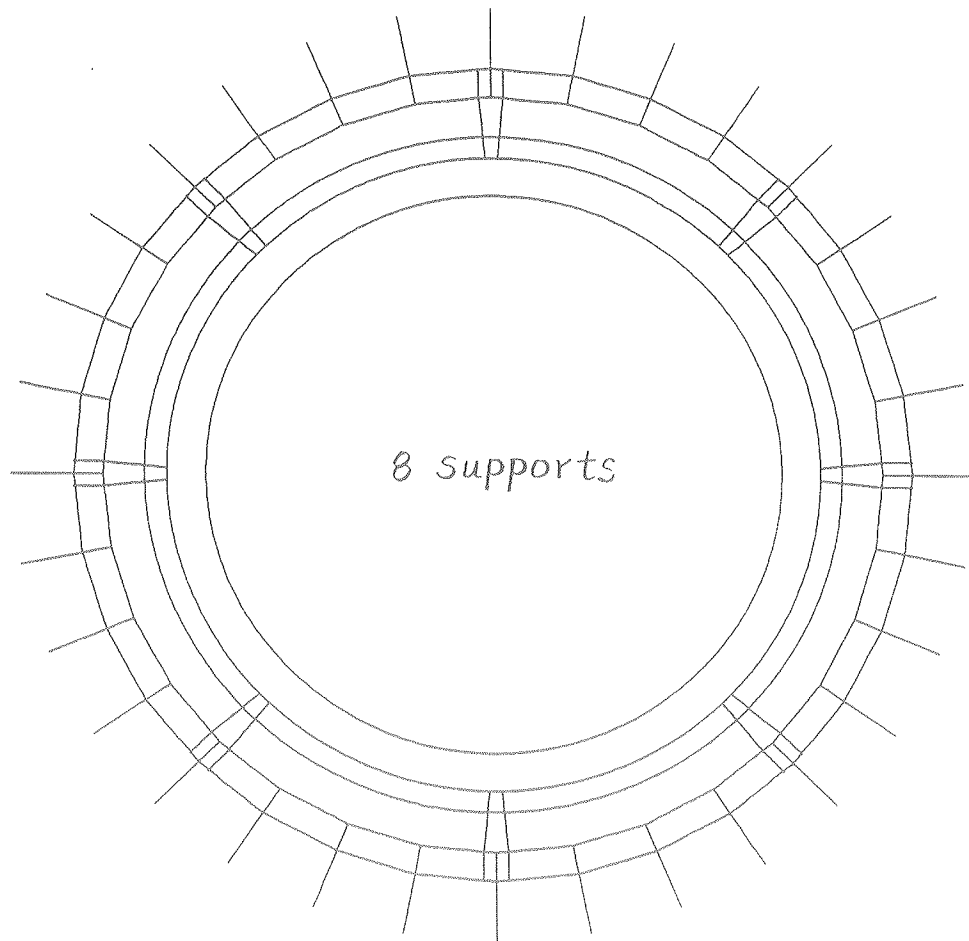
Be-Al, Be--good radiation thickness. Properties uncertain.

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Geometric constraints on support beams

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## QUESTIONS

If there are 8 supports on each end, as shown in previous VG,

1. Can the chimney-end supports be 3" thick in 80 mm gap?
2. Can the chimney-end supports be 2" wide at the inner/cryostat end (dimension *b*) and occupy 3.3% of the inner circumference?
3. Can the chimney-end supports be 11" wide at the outer/calorimeter end (dimension *a*) and occupy about 15% of the outer circumference?
4. Can the chimney-end support attach to the steel section of the EM barrel? If so they can be 15.5" long (dimension *l*).

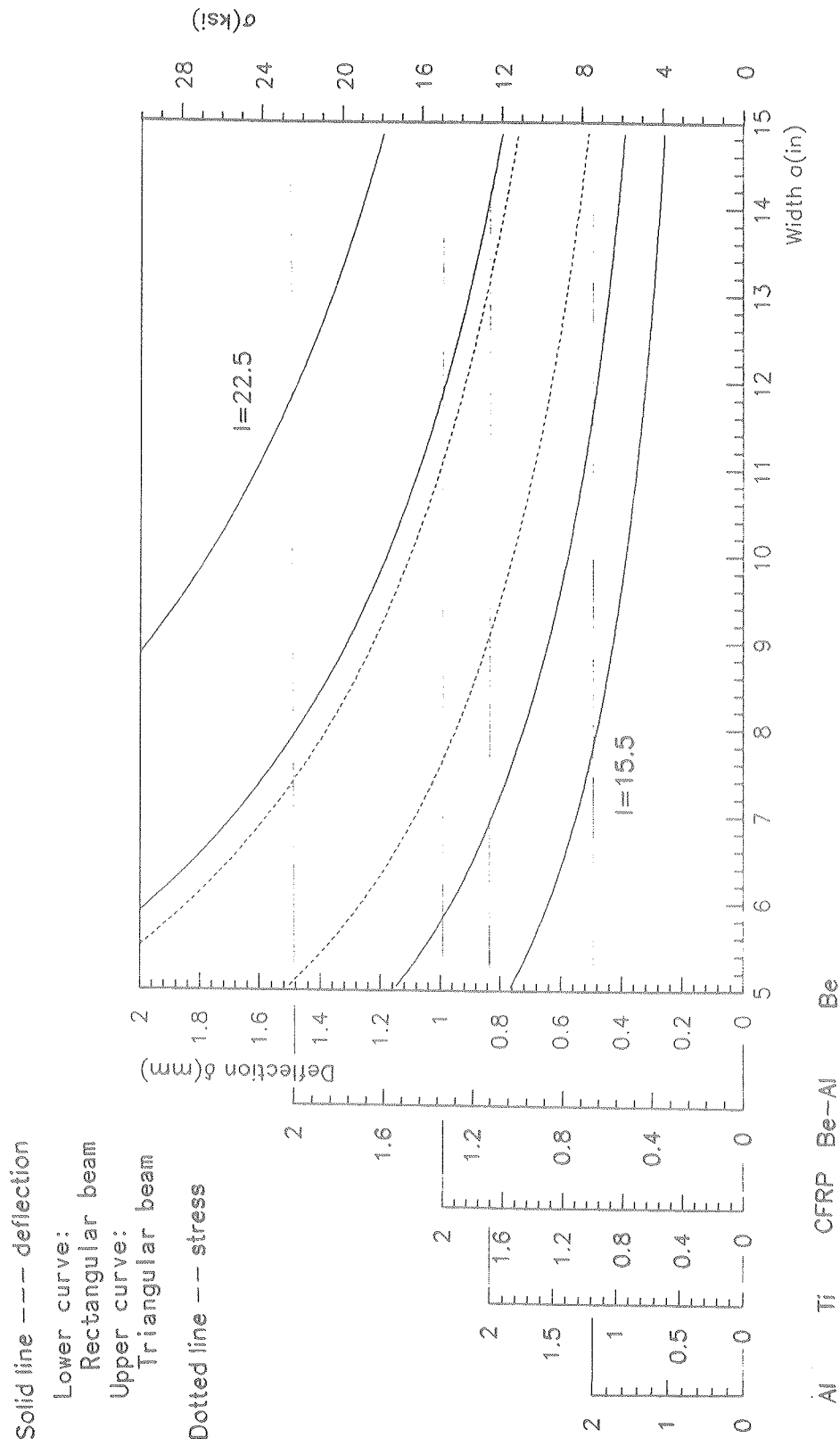
## CONSEQUENCES OF ANSWERS

1. If the answer to all four questions is "Yes", then aluminum will work from deflection and stress, adding ~1X0 to cryostat thickness. Total thickness ~3.8X0.
2. If the answer to #4 is "YES", but #3 is "No, the maximum *a* can be is 6 inches"--then Al won't work. Ti will work, but will add 2.2X0 to cryostat thickness; ~5X0 total. CFRP might work.
3. If the answer to question #4 is "No, the supports must attach to HAC1"--then the supports will be 22.5" long. 8 supports made of Be-Al alloy or Be will work, other materials won't. Are Be and Be-Al good materials for this use? What will they cost?

## BUT

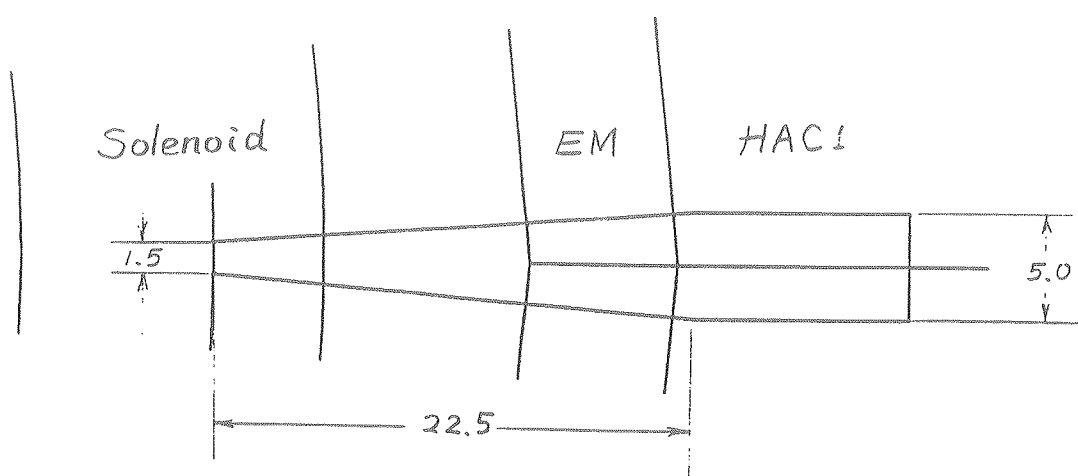
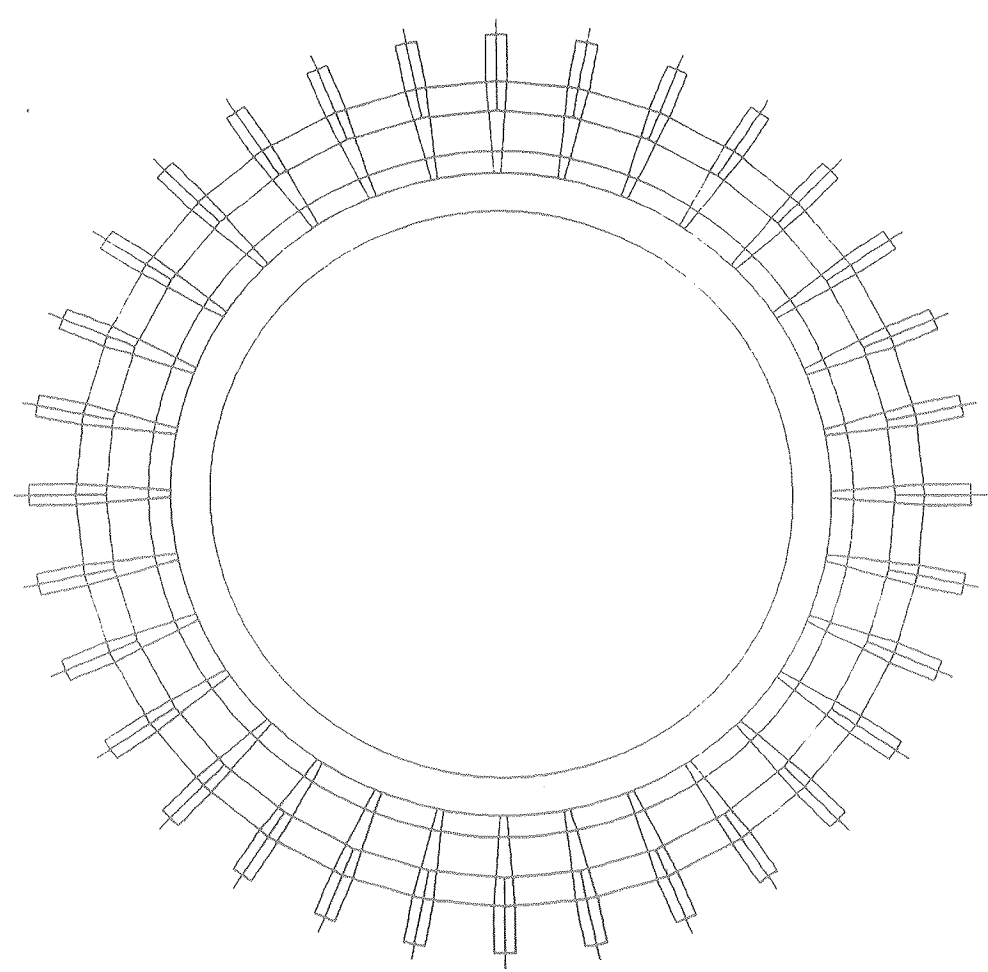
Calorimeter experts say the supports MUST attach to HAC1. Ignoring Be and Be-Al, this means that 8 simple supports will not work. Our proposal follows.

# Determine Support Beam Width



## OUR NON-PROPOSAL

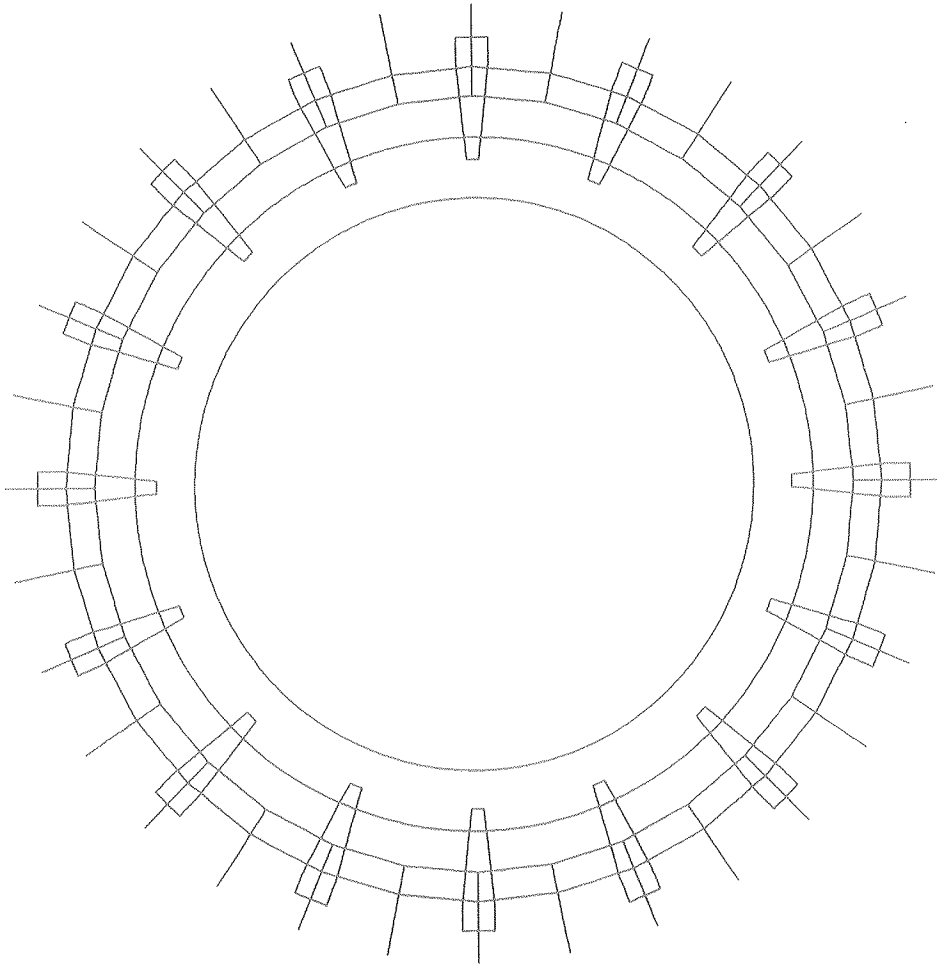
32 Ti supports as shown below are satisfactory from deflection and stress, but they occupy 10% of the circumference at the cryostat radius. We believe we can make 16 supports work.



## PROPOSAL

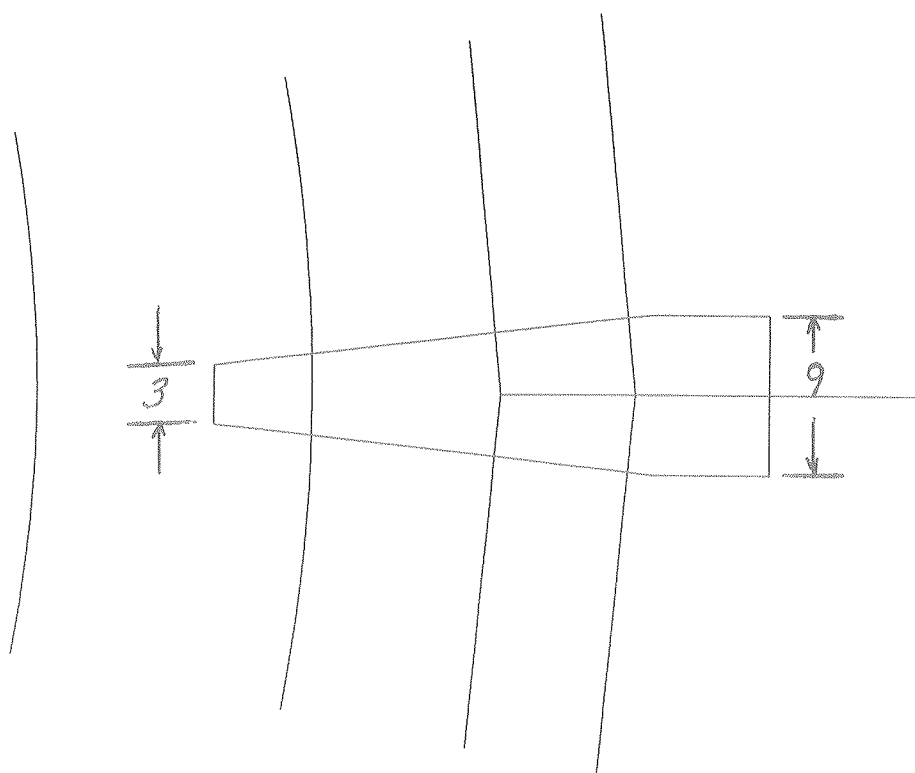
16 Ti supports , attaching to HAC1 at wedge-to-wedge connecting bracket. Each support is 3" x 9" x 3" as shown.

We are investigating the use of a gusset between wedges to reduce the outer width.



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## SUPPORTS FOR FAULT CONDITION

Because of the 4 mm clearance between support and EC, the support system can handle an 80-tonne axial force w/o damage to EC.

We have not identified a credible fault condition with axial forces greater than 80 tonnes.

Axial forces >80 tonnes could be handled by "bumpers" at both ends going through EC/EM to EC/hadronic. Eight, 1-inch holes through the EC/EM on each end probably adequate for fault forces of several hundred tonnes.

We see no technical reason at this time to have bumpers. What does the magnet designer recommend?

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